

CIVILIAN RESEARCH PROJECT

**A NEED FOR CHANGE: THE LOOMING ENERGY CRISIS**

by

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## **ABSTRACT**

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The United States' (US) national interest in the Middle East has grown more complex over the years, but fundamental concerns regarding oil protection and availability remain a central theme. US dependency on Middle Eastern oil to meet ever-increasing energy consumption demands have returned to the levels found just prior to the 1978–1980 oil crisis. Current Middle Eastern instability and the rise of the al-Qaeda insurgency revive questions regarding the ability of the US to weather an abrupt and significant loss of Middle Eastern oil. This paper analyzes current and projected energy sources, consumption demands, risk associated with foreign energy dependencies, and alternative energy sources. This paper also addresses implications to the economy, the military, and other nations should an energy crisis appear prior to the elimination of foreign energy dependencies. Finally, this paper provides policy recommendations for strategic leaders, planners, and politicians regarding prudent measures needed to minimize the required use of force to protect the flow of oil from the Middle East in the advent of another oil crisis.

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*“In little more than two decades we’ve gone from a position of energy independence to one in which almost half the oil we use comes from foreign countries, at prices that are going through the roof. Our excessive dependence on OPEC [Organization of Petroleum Exporting Countries] has already taken a tremendous toll on our economy and our people.... This intolerable dependence on foreign oil threatens our economic independence and the very security of our nation. The energy crisis is real. It is worldwide. It is a clear and present danger to our nation. These are facts and we simply must face them.”*

–President Jimmy Carter, televised speech, 15 July 1979 [1]

## **A NEED FOR CHANGE: THE LOOMING ENERGY CRISIS**

The United States’ (US) national interests in the Middle East have grown more complex over the years. However, fundamental concerns regarding oil protection and availability remain a central theme given that the volatile Middle East accounts for over 51% of proven oil and gas resources in the world. Growing US dependency for foreign energy sources raises the likelihood for continued risk to the economy as exhibited by energy shortages and price increases during the 1973 oil embargo, the 1978–1980 Iran-Iraq War, the 1990–1991 Iraqi invasion of Kuwait, the rise in oil prices in the late spring of 1999, and the 2003 War in Iraq. This risk escalates after factoring in the increasing demand for foreign energy sources by the growing economies of China, India, and Brazil against the backdrop of a depleting supply of non-renewable fossil fuels. In recent years, US dependence on Middle Eastern oil to meet ever rising energy consumption demands has returned to the levels found just prior to the 1978–1980 oil crisis [2], a level that then President Carter declared in 1979 as a goal for the nation never to surpass again [3].

Current instability in the Middle East and the rise of the al-Qaeda insurgency revive questions regarding the ability of the US to weather an abrupt and significant loss of Middle Eastern oil. Reducing this dependency must become a top priority for any White House administration, or the economy and national security interests will remain inevitably linked to the Middle East with even greater likelihood than in the past for a prolonged military presence to protect these rich foreign oil reserves.

### **Background and Perceptions**

Energy security should have been a key component of any White House administration since the mid-1960s when the Middle Eastern countries became the largest oil producers in the world.

However, little public debate has transpired regarding energy policy other than from an environmental perspective or during the aftermath of an energy crisis of short supply or high prices. This is not a problem created by President George W. Bush. Both Democrat and Republican administrations share in this failure to deliver a balanced, long-term energy policy that is central to the US economy and our nation's security. Unfortunately, decades of energy policy drift, unintended consequences of energy deregulation, and cheap oil have created a conundrum where the American people need to be told the truth: "there are no easy or quick solutions" to the energy problems facing our nation [4].

Contrary to political campaign rhetoric, energy independence is not possible within the next two decades even if the White House enacted sound decisions today that incorporate a long-term outlook regarding energy security. Alternative energy sources, such as solar and wind energy, could reduce but not replace the consumption needs provided by foreign oil imports over the next two decades. Current technology of these alternative energy sources, projected gains in energy efficiency, and limited energy storage capabilities make these proclamations unrealistic. Consequently, we must seek alternative energy technologies in combination with continued reliance on fossil fuels and conservation policies in a period of transition towards reduced foreign energy dependence.

No White House administration has been able to pass through Congress a comprehensive energy policy that links foreign policy and energy security aims while simultaneously addressing environmental considerations. This is really not very surprising because of the inherent conflict within the legislative and executive branches of the US system of government. The president represents the nation as a whole while congressional members typically pursue local issues and are less inclined to support broad national or public interests. The consequence of "all politics are local," once opined by former Speaker of the House Thomas "Tip" O'Neill, is that well-financed special interest groups and powerful lobbies significantly influence the political outcome of all energy policy proposals and submissions. Invariably, sitting presidents propose energy policies that are limited in breadth, focusing on perceived near or long-term issues designed to affect either energy supply or demand rather than proposing a comprehensive plan that would encounter stiff interest group and lobby resistance [5].

President Carter proposed a series of conservation initiatives (e.g., 55 mph speed limit, thermostat and insulation guidelines, and fuel efficiency), established the Strategic Petroleum Reserve (SPR), emphasized the need for improvement in nuclear power safety, banned nuclear reprocessing facilities, established goals to increase production of coal and use of shale; and initiated research and development (R&D) of alternative energy sources [6]. President Ronald Reagan sought a phased deregulation for oil and price control in an effort to make energy policy more market driven. He also rescinded Carter's policy banning nuclear reprocessing facilities [7]. President Bill Clinton focused on initiatives to combat global warming with environmentally friendly initiatives to include support for the Kyoto Protocol and elimination of R&D funding for nuclear power generation initiated by President Carter aimed at solving the proliferation, waste, and safety concerns regarding nuclear power [8]. President Bush reinstated funding for nuclear power generation R&D, requested funding to modernize oil refineries and coal factories, and proposed modest alternative energy funding. President Bush sought to increase exploration for oil and to relax many costly environmental guidelines. President Bush also rejected the Kyoto Protocol and chose not to submit it for Senate ratification because he believed it would harm the US economy and not significantly alter the effects of environmental damage [9].

Although oil is a cheap source of energy, virtually all analysts agree that the cost per barrel will sky rocket in a few decades when resource production is well past its prime (i.e., Hubbert's peak) and supply cannot keep up with demand [10, 11, 12].<sup>1</sup> This does not mean that oil resources will dry up but rather the cost to produce oil will increase as producers struggle to meet demand with fewer barrels per day pumped out of known oil reserves.<sup>2</sup> As emerging nations such

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<sup>1</sup> "Hubbert's Peak" signifies the imminent depletion of oil and gas using a bell curve to represent the rise and eventual fall in oil production. Many analysts believe that the "Hubbert Curve" does not account for advances in technology, prices, and policies. Instead of a bell curve, these analysts state that a curve skewed to the right more appropriately signifies the depletion of oil and gas.

<sup>2</sup> After a certain point, the cost to pump more oil out of a known reserve is cost prohibitive. As the cost of oil increases, it becomes more economical to pump additional oil out of these "depleted" reserves. In theory, sufficient oil exists to extend the pumping of oil a few more decades but it will come at a significantly higher cost than that found today for oil. The key point is that any figure that references "Known Resources" for a given energy source is misleading because it ignores future technology advances to extract these sources at lower costs or the markets willingness to pay more for extraction as demands exceeds supply.



as China and India consume more energy for their expanding economies, the global demand for oil will grow putting even more of a burden on Middle Eastern oil producers. Compounding the problem is the instability of the Middle East and the consequences to the rest of the world if production significantly reduces due to renewed wars or regime changes. The future implication is that, without sufficient alternative energy sources, the unpredictability of oil supplies and higher prices will adversely affect US and global markets prompting political action for secure access to needed oil supplies.

Energy is a public good and, as a result, governmental incentives must be married with any energy policy to gain public support of the American people and industry. Without compensation and governmental action, industry and the American people have little incentive to fill the energy void. Unfortunately, the politics of enabling change are formidable.

*“What you see too often in Washington and elsewhere around the country is a system of government that seems incapable of action. You see a Congress twisted and pulled in every direction by hundreds of well-financed and powerful special interests. You see every extreme position defended to the last vote, almost to the last breath by one unyielding group or another. You often see a balanced and a fair approach that demands sacrifice, a little sacrifice from everyone, abandoned like an orphan without support and without friends” [13].*

Only after a significant crisis will partisan issues subside and Congress rally to support a planned response to the crisis as seen during the aftermath of the 9/11 terrorist attacks and Hurricane Katrina’s destruction of New Orleans. Although the various oil crises to date have captured the attention of the American people, the mixed opinions of various special interest factions and the relatively short duration of these crises have prevented the galvanization of the American people into a uniform state of sufficient urgency to cause Congress to declare war on energy dependence. This does not bode well for successfully getting a comprehensive energy policy linked to foreign policy and energy security aims, while simultaneously addressing environmental considerations through the political wickets. The lack of a sound energy policy might very well pass along to our children the future need for military action to protect the US economy and its way of life.

The US is not alone in the struggle for energy independence. China and India are also wrestling with new energy demands to feed their growing requirements. Great Britain, France, Germany, Japan, and others have invested heavily in alternative technologies over the past few

decades to include renewable energy. However, they still face the daunting task of keeping up with growing energy consumption and stunted nuclear programs [14]. In response to this energy security risk, the United Kingdom recently launched an energy review that may reinitiate a new generation of nuclear power plants. On 29 November 2005, Prime Minister Tony Blair stated that the time had come to debate the difficult issue of nuclear power. He stated that energy policy was “back on the agenda with a vengeance. Energy prices have risen. Energy supply is under threat. Climate change is producing a sense of urgency” [15].

## Sources of Energy

Energy experts typically classify energy sources into two major categories: non-renewable and renewable. Non-renewable energy sources include fossil fuels (e.g., oil, coal, gas, and shale) and nuclear power (e.g., uranium, plutonium, thorium, and spent fuel). Non-renewable sources of energy have finite supplies due to the epochal time required for regeneration. Once non-renewable sources are exhausted, they are forever gone without replenishment. Renewable energy includes hydropower, geothermal, biomass, solar, wind, ocean wave, tidal, and thermal energy. The sun is the source of all renewable energy (except geothermal and tidal) and as such, there is virtually a limitless supply of renewable energy.<sup>3</sup>

Table I depicts the known availability of the various energy resources on a worldwide basis [16]. To ensure an equivalent comparison between the various non-renewable and renewable energy resources, the quantities were all converted into quads. One quad is the equivalent of  $10^{15}$  British thermal units (Btus), 0.182 billion barrels oil equivalent (boe), 0.0248 billion tonnes oil equivalent (toe), and 0.036 billion tonnes of coal equivalent (tce).

The significant information drawn from Table I is that even with an average annual percent growth of 2–3% in worldwide energy consumption, it is unlikely that global consumption would deplete oil and gas resources within the next 30–40 years. The problem regarding oil is more related to its security vulnerability (i.e., unimpeded availability), rising prices, and environmental impact of harmful emissions into the atmosphere (i.e., a significant cause of global warming).

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<sup>3</sup> The common misperception is that hydrogen is an energy source. It is not. Hydrogen is an energy carrier and like a battery, it requires energy to make it.

Although the data of Table I reflects an abundance of non-fossil fuel energy that far exceeds worldwide consumption demands, the table does not portray the environmental, economic, technical, or political issues associated with these other energy resources that may prevent them from becoming a replacement energy alternative to oil and gas.

**Table I. Worldwide Energy Resources and Consumption Totals**

<u>Worldwide Non-Renewable Energy Resources</u> (1 quad = $10^{15}$ Btus)	
Fossil Fuels <sup>1</sup>	
Oil (Known)	16,200 quads
Gas (Known)	12,700 quads
Oil and Gas (Probable unexploited Resources)	50,500 quads
Coal (Known)	138,000 quads
Nuclear Fuel <sup>2</sup>	
Uranium	22,500 quads
Uranium (Breeder Reactors)	1,400,000 quads
<u>Worldwide Renewable Energy Resources</u>	
Solar Radiation Delivered to Entire Land Mass <sup>3</sup>	767,600 quads/year
Solar Radiation on a 100 square kilometer area	0.557 quads/year
Geothermal <sup>4</sup>	
Hydrothermal	130,000 quads
Geopressured	540,000 quads
Magma	5,000,000 quads
Hot Dry Rock	105,000,000 quads
<u>Worldwide Energy Consumption</u>	
Total World Energy Consumption <sup>5</sup>	421.5 quads/year
US Energy Consumption <sup>5</sup>	98.2 quads/year
Source: Hans Mark, "The Problem of Energy," The University of Texas at Austin, National Academy of Engineering, 30 April 2004.	
<sup>1</sup> Updated using EIA, "Annual Energy Outlook 2005."	
<sup>2</sup> Updated using World Nuclear Association, "Supply of Uranium," 25 Sep 2005.	
<sup>3</sup> Updated using "WEC Survey of Energy Resources 2001 – Solar Energy"	
<sup>4</sup> Tester et al, Sustainable Energy, 2005, p. 468.	
<sup>5</sup> Updated using EIA, "International Energy Annual 2003."	

## Fossil Fuels

Table II depicts the known geographical distribution of oil and gas [17]. The table percentages reveals that the countries in the most unstable region in the world—the Middle Eastern territories of Saudi Arabia, Iraq, Iran, Kuwait, and the United Arab Emirates (UAE)—possess almost two-thirds of the world's known oil reserves. In addition, over one-third of the

known gas reserves are also located in the Middle Eastern countries of Iran, Qatar, Saudi Arabia, the UAE, and Iraq.

**Table II. Geographic Distribution of Oil and Gas**

<u>Known Resources</u> (1 quad = 10 <sup>15</sup> Btus)			
Oil: 16,200 quads		Gas: 12,700 quads	
Saudi Arabia*	22.1%	Russia	26.7%
Iran*	11.1%	Iran*	15.3%
Iraq*	9.7%	Qatar*	14.4%
Kuwait*	8.3%	Saudi Arabia*	3.8%
United Arab Emirates*	8.2%	United Arab Emirates*	3.4%
Venezuela*	6.5%	Nigeria*	2.8%
Russia	6.1%	Algeria*	2.5%
Kazakhstan	3.3%	Venezuela*	2.4%
Libya*	3.3%	Iraq*	1.8%
Nigeria*	3.0%	Kazakhstan	1.7%
United States	2.5%	United States	2.9%
All others:	15.9%	All others:	22.4%
* OPEC members			
Source: Hans Mark, "The Problem of Energy," The University of Texas at Austin, National Academy of Engineering, 30 April 2004.			
<sup>1</sup> Updated using EIA, "International Energy Outlook 2005," July 2005			
<sup>2</sup> Updated using BP "Global Statistical Review of World Energy 2005,"			
<a href="http://www.bp.com/genericsection.do?categoryId=92&amp;contentId=7005893">http://www.bp.com/genericsection.do?categoryId=92&amp;contentId=7005893</a>			

In large part, US national interests in the Middle East are closely associated with these rich reserves [18].<sup>4</sup> It is more complex than simply stating, "It is all about oil," as many pundits like to claim, but it is undeniable that the need to preserve access to Middle Eastern oil influences US national strategy and foreign policy. The lack of energy independence or sustainable energy security since the 1950s have plagued foreign policy decisions of both Republican and Democrat administrations as represented in their tacit support of regimes that do not share the US democratic and human rights' concerns.

President George W. Bush's comment on the growing US reliance on imported oil echoes similar sentiments of former President Carter. "[T]his dependence on foreign oil is a matter of

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<sup>4</sup> Other contributing factors include staunch US support of Israel and efforts to contain the former Soviet Union's influence in the region during the Cold War.

national security. To put it bluntly, sometimes we rely upon energy sources from countries that don't particularly like us" [19].

Unlike oil and gas, the US possesses an abundant 27% of the world's coal resources that could last well into the next century. The technical capability to convert coal into natural gas and crude oil exists but it is not done on a large scale because the conversion process is not cost effective based on the current price of natural gas and oil. Unfortunately, coal is not a desirable alternative energy source to US foreign dependence on oil and gas because of the environmental impact of its use. Coal is a major cause of acid rain, and like other fossil fuels, is a principle source of global warming.

Shale is also abundant in the US, but it is too expensive to process based on the current price of oil. In addition, it consumes substantial energy during the conversion process. Shale oil also shares the same fossil fuel trait of causing harm to the environment. Nevertheless, the US could employ shale oil as an alternative energy source if the price of oil sky rockets.

## **Nuclear Power**

Nuclear power gained strength for commercial use with President Dwight Eisenhower's "Atom for Peace" speech to the United Nations (UN) General Assembly in 1953 [20]. However, it took until the 1970s for nuclear power plants to play a significant role as an energy producer for the US. It was also during this period that vocal objections to nuclear power made headway into the political review process. Concerns raised included the unsafe release of radiation, nuclear waste and contamination, potential proliferation and theft of plutonium, a core melt down or explosion, and a basic mistrust of government [21, 22]. In response, President Carter declared the end of breeder reactors in the naive hope that other countries would follow his lead and stop the production of weapons grade plutonium [23]. While the US halted its breeder reactors, nuclear-capable countries did not stop their breeder reactor development.

Nuclear power plants use a process called *fission*, or atom splitting, to produce a nuclear reaction causing a release of energy. Most nuclear reactors use enriched uranium although reactors could easily use thorium as the fissile fuel source. One of the arguments often stated by opponents of nuclear energy is that there are not sufficient quantities of known uranium resources available to support a resurgence of new nuclear power plants. However, this

contention omits that limited demand for new exploration has marginalized attempts to discover new uranium deposits. Conventional uranium resources could easily double with a significant increase in new exploration. A doubling of price from present levels for uranium would increase uranium resources tenfold. Technology also enables the unconventional extraction of uranium from seawater and phosphate deposits [24]. Nuclear reactors may also use former military stocks of uranium and plutonium that energy analysts do not count in the known uranium calculations. Thorium, an alternative source of fissile fuel, is three times more abundant than uranium [25].

A breeder reactor makes more fissile fuel than it consumes and hence its name. The advantage of a breeder reactor is that it makes fissile fuel nearly inexhaustible. The breeder reactor can convert a more plentiful form of uranium (U238), which is normally non-fissile, to a fissile fuel in addition to enriched uranium (U235). The disadvantage of a traditional breeder reactor is that it produces plutonium that can make an atomic bomb and is highly lethal if released into the environment because of its toxicity.

An integrated fast breeder reactor based on efforts at Argonne National Laboratory (ANL) solved virtually all the concerns associated with nuclear power. ANL developed a passive reactor that shuts down naturally without human intervention, recycles the fuel in an integrated process that makes it impossible to extract plutonium, minimizes the quantity of waste material, and reduces the half-life of the remaining waste to less than sixty years from what was otherwise 100,000 years and more [26, 27, 28]. Although President Clinton halted funding prior to final testing of this new type of breeder reactor, President George W. Bush recently reinstated funding for continued testing.

## **Renewable Energy**

Hydropower generates the greatest amount of renewable energy usage in the US. A significant advantage of hydropower is that it provides both a source (e.g., mechanical or electric) and storage (e.g., dam or reservoir) of energy. Although hydropower is competitive in pricing with other sources of energy, energy experts do not expect additional growth for large-scale plants in the US because of numerous concerns to include environmental problems and site dependencies.

Solar energy is bountiful in supply and many advocates claim it should be the alternative energy source to fossil fuels and nuclear power requirements. The sun radiates the US with enough potential energy to provide over 40,000 quads per year [29]. However, a closer analysis of solar energy reveals that certain locations are better at receiving the sun's radiation and the demand for energy may not map solar energy availability. Limitations include the fact that only a small proportion of the total landmass is available to capture solar radiation; solar energy is intermittent; a large area is required to capture solar energy for centralized use; and the solar energy conversion efficiency only ranges from 12–30% depending on the technology used.

To replicate the equivalent amount of electricity provided by the Hoover Dam, a solar farm would require approximately twenty square miles. In addition to the required area, the height and brightness of the central receivers on the towers present a different issue. For unit sizes over 100 MWe, the receiver for concentrating solar power (CSP) would require heights of over 200 m [30]. An alternative to CSP in farms is decentralizing solar power to each building and house to supplement electricity requirements. Part of the decentralized strategy could be either to store energy not required at the time of conversion or sell it back to the electric grid; thus, enabling other consumers to use excess capacity.

Unfortunately, solar energy advocates are misleading the public by claiming that solar energy is a viable replacement for fossil fuel and nuclear energy. Solar energy is a renewable source that is environmentally friendly and a contributor to, but not the silver bullet for, the US to achieve energy security, sustainability, or independence.

Wind power is another environmentally friendly alternative energy source that is potentially plentiful. Wind generates energy resulting from differences in solar heating in the air, land, and sea surfaces. For centuries, humans have used wind power in support of local needs such as pumping water or mills. Today, wind power turns turbines, which in turn rotate generators to produce electricity. Wind energy gained prominence following the 1973 oil crisis as an alternative energy source. In the US, the boom period for wind power occurred during the late 1970s through the early 1990s. However, a decline in interest was precipitated by the expiration of federal and state (e.g., California) tax credits and the low price of oil leading to the bankruptcy in 1996 of Kenetech Windpower, the world's largest wind power manufacturer. Since 1999, the US has again experienced a surge in wind power but nowhere near the level of growth seen in

Europe. Europe continued to expand its use of wind energy because of environmental concerns associated with CO<sub>2</sub> driven global warming and a much higher oil price due to consumption/conservation taxes [31].

The constraints associated with wind power are numerous but not insurmountable. Wind power is restricted to selected locations that provide sustained and strong winds, requires a large landmass, is dependent upon winds that change, is dependent upon expensive transmission systems to support distant consumers, and requires an energy storage capability not economically feasible today.

Geothermal energy originates from inside the earth and is an enormous potential source of alternative energy. Some countries, such as Iceland and the Philippines, have harnessed this alternative energy source with remarkable success; but to the surprise of many, so has the US. Geothermal energy is second only to hydropower as a renewable energy source for electricity generation. The western portion of the US (to include Hawaii) has the greatest likelihood of tapping the geothermal potential. The world's installed base of geothermal energy resources has achieved an average growth rate of 8.5% per year since 1920 [32]. However, the US needs additional R&D funding for identifying suitable locations and technological advancements to expand the use of geothermal energy as a viable alternative energy source with minimal environmental issues.

Biomass is living plant matter and organic waste. Biomass is a versatile energy source that we can use to generate heat, steam, electricity, and liquid fuels to include synthetic gas. Biomass is widely available and remains an important source of energy in many developing countries. Although biomass is a renewable energy source, it is possible for demand to exceed supply in local areas causing depletion. Defoliation is one such example where consumption exceeds the cycle rate of regeneration.

Biomass has shortcomings as an alternative energy source for large-scale use. Its consumption releases harmful greenhouse gases; excessive use could deplete resources (e.g., deforestation) that are vital to the atmosphere such as being a sink for CO<sub>2</sub> absorption; and its cost for large capacity use currently exceeds that of fossil fuels.

Ocean wave, tidal, and thermal energy are all viable alternative energy sources to fossil fuels, but they are not likely to become a major output source of energy because of the high capital cost



required for implementation. It is expected that experiments using small-scale models will continue but with more academic curiosity than economic viability.

## **Energy Consumption**

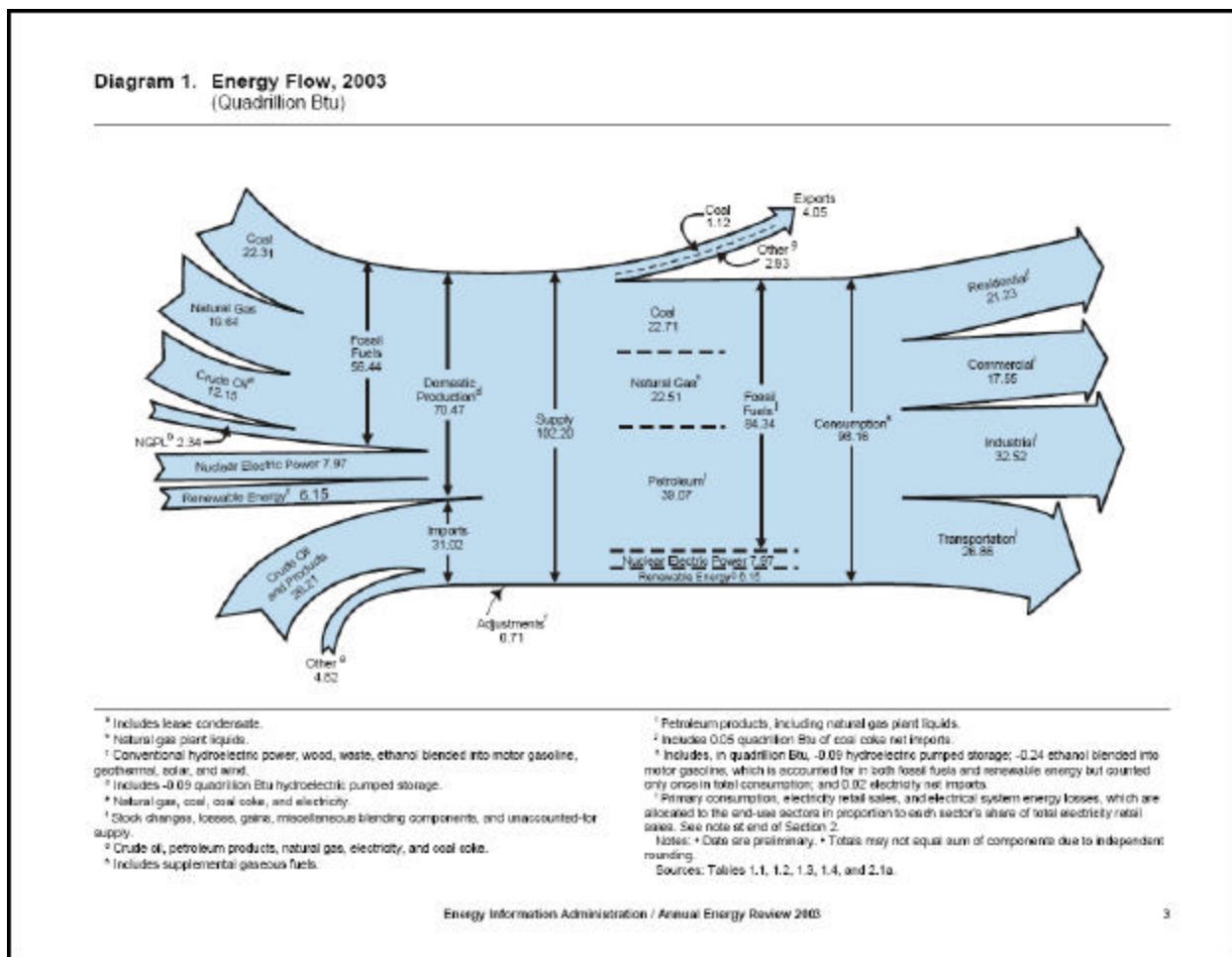
Until the start of the Industrial Revolution in the 18<sup>th</sup> century, renewable sources (e.g., using biomass for heat and muscular energy; wind) met almost all energy needs [33]. Since then, fossil fuels have become the primary energy source driving machines of increasing power and the force powering the US economic engine.

Oil provides a low cost energy source to run the transportation sector and provides over 29% of the fuel needed for the Industrial sector. Natural gas is a significant contributor to the Industrial, commercial and residential sectors. Coal contributes approximately 53.5% of generated electricity in the US.

Figure 1 provides an energy flow overview of production and consumption by energy source [34]. Fossil fuel provides approximately 86% of the total US yearly energy consumption requirements. A blend of renewable and nuclear energy provides the remaining 14%. Fossil fuel imports, primarily oil and gas, account for 28% of US yearly energy consumption. Approximately 62% of oil consumed in the US is imported and the Energy Information Administration (EIA) estimates that by 2025 the percentage will expand to 76% [35].

Although the US has successfully diversified oil imports away from the Middle East, the Middle East still represents 20.4% of oil consumed in the US [36]. As demand increases, energy experts expect this percentage from the Middle East to rise with it.

Fossil fuels are a relatively cheap source of energy when compared to the other forms of energy. “The maturity and size of the fossil industry, its existing infrastructure, and its attractive economics are major challenges to the penetration of alternative energy technologies” [37]. Energy economics seldom level the playing field by factoring total lifecycle costs of fossil into the various cost models.



**Figure 1. Energy Flow, 2003.**

The cost of oil spills, environmental and occupational health related issues, long-term impact of global warming, use of the military to protect the flow of oil, second and third order impact of oil price volatility, future price of oil when consumption demands exceeds production and resource availability, etc. are not factored in the price of gas paid at the pump. Yet, most analysts dismiss alternative energy sources as uneconomical because they compare them to the “subsidized” cost of fossil fuels [38, 39].<sup>5</sup>

<sup>5</sup> Studies such as that found in “Future of Nuclear Power: An Interdisciplinary Study,” use economic analysis that although informative does not factor in environment, health and protection related costs associated with oil that otherwise would dramatically alter their conclusions. However, the MIT study does show that a CO<sub>2</sub> tax on fossil fuels would make nuclear energy economical attractive.

Nuclear energy contributes over 20% to the generation of electricity and roughly 8% of total US energy consumption. Renewable energy sources as a group only provide approximately a 6% share of the total US energy consumption [40].

## **Energy Risks**

Although the US is the leading energy producer in the world, the US appetite for energy exceeds present production capacity by approximately 27 quads. The EIA forecasts by 2025, the US energy consumption requirement will grow to 133.2 quads from approximately 98.22 quads in 2002 [41]. This projected growth of a mere 1.3% per year will exacerbate the current energy security problem. US dependence on energy imports will increase to an EIA-estimated 51 quads because production will not be able to keep pace with rising demand. Without advances in alternative energy sources coupled with increased conservation measures, the consequence of increasing US dependence on foreign energy carries significant risk to national security, the economy, and the American way of life.

The US has diversified its foreign energy imports among a portfolio of export producing countries, has made modest efforts regarding energy conservation, and has established the SPR since the late 1970s at the urging of then-President Carter. Subsequent presidents have added their perspective on how best to reduce the risk of energy dependence but at no time has the US truly mitigated the risk or slowed down foreign energy dependency.

The original objective of the SPR was to provide a minimum of six months oil reserve protection to the US against a prolonged oil boycott. However, Congress has never provided sufficient funding to maintain the SPR at a six-month reserve level based on increasing oil consumption demands. Today, the SPR will provide less than sixty days of reserve [42].

Non-OPEC countries, such as Canada and Mexico, have increased oil production exports to the US and now account for 57.9% of imported oil. OPEC imports account for 42.1% of the oil imported to the US, of which the Middle East (i.e., Persian Gulf nations) provides 20.4% [43]. Although this diversification has helped reduce the risk of oil supply shortfalls from any one source, it has not dampened the consequences to the US economy, foreign policy, and national security decision making.

## **Middle Eastern Instability**

The instability of Middle Eastern oil producing countries is a current risk that consumes the strategic thinking and foreign policy of most nations dependent upon oil imported from this region. Certainly, the free flow of oil was a significant factor in the US-led, UN-sanctioned coalition formed following Iraq's 1990 invasion of Kuwait. Pundits have also speculated that oil may have been a politically unstated concern regarding the 2003 war in Iraq, amongst other publicly stated concerns about weapons of mass destruction (WMD) and possible terrorist ties with al Qaeda, because Iraq controls approximately 9.7% of the world's known oil reserves.

Iran, a country that controls approximately 11.1% of the world's known oil reserves, adds to the region's turmoil due to its nuclear development intentions, anti-American sentiment, and a stated desire to wipe Israel off the map. However, Iraq and Iran pale in comparison with the importing nations' concerns regarding the stability of the Saudi monarchy since Saudi Arabia controls approximately 22.1% of the world's known oil reserves. "Although by no means a certainty, the growing internal problems inside the kingdom as well as the increased strains in Saudi-American relations since September 11 both indicate that the downfall of the monarchy may be more likely now than in the past" [44].

King Abdullah became head of the Saudi monarchy following the death of King Fahd on 1 August 2005. King Abdullah's advancing age suggests that another change in the Saudi monarchy may not be too far away. The other two most powerful members of the royal family are Crown Prince Sultan and Prince Nayef. Although Crown Prince Sultan is next in line, we cannot overlook the power welded by Prince Nayef, Saudi's Interior Minister. Prince Nayef has firm control of the kingdom's internal security with responsibility of providing protection to the royal family. "The Saudi monarch functions as the intermediary between two distinct political communities: a Westernized elite that looks to Europe and the US as models of political development, and a Wahhabi religious establishment that holds up its interpretation of Islam's golden age as a guide" [45]. King Abdullah's past actions as Crown Prince reflect a support towards reform while Prince Nayef sides with Wahhabi clerics and shares many anti-American goals with al-Qaeda [46].

Prince Nayef will likely balance the differences in his favor while mindful that an insurgency by al-Qaeda or even Wahhabi loyalists may jeopardize his own privileged standing.

*“Virtually everyone, however, seems to agree that the demise of the Saudi monarchy would have a tremendously negative effect on both the international economy and world politics generally. This is because the most likely successor to the Saudi monarchy is generally seen as a virulently anti-Western Islamic fundamentalist regime whose rise to power alone will result in a dramatic, sustained increase in the price of oil” [47].*

The question that the US and the international community with significant oil dependencies (e.g., NATO members, China, India, Japan, etc.) must wrestle with is what response to take if the Saudi monarchy falls.

“History has not been kind to oil regimes undergoing revolutionary change. In all known cases, the result has been a precipitous decline in production capacity, which can be long lasting” [48]. The resulting economic impact could cause high fuel prices leading to a recession if of short duration or an economic collapse of global proportion if of long duration precipitated by the shut down of businesses, travel and Stock Market crashes. Somewhere in the course of the worst-case scenario, the president along with a coalition of oil dependent nations may call upon military forces to restore order to the global economy.

Other current risks may come from suppliers such as Venezuela especially when political views differ so greatly between trading partners or from terrorists aimed at causing disruptions to the oil/gas supply lines or energy infrastructure.

## **Future Risks**

Future risks will likely remain the same as today’s current risk as they relate to Middle Eastern instability, other exporting countries, and terrorist threats. An added dimension of risk in the future will be significantly higher prices for crude oil and supply that cannot keep up with global demand. If China maintains its accelerated growth pace well into the future with a population that dwarfs that of the US and the European Union combined, then it is probable that China will overtake the US as the leading consumer of energy in the world before the end of the 21<sup>st</sup> century and maybe as early as 2035 [49].<sup>6</sup> Another formidable risk in the future will be the impact that fossil fuel emissions have on the environment, the impact on health costs, and the

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<sup>6</sup> China eclipses the United States in energy consumption in 2032 by extrapolating EIA’s estimated average annual percentage change for both countries.

future cost associated with employing a more environmentally friendly approach to sustainable energy. Finally, if Congress does not approve energy policies and provide associated funding for the development of alternative energy sources, then these sources will not be sufficiently robust when needed to keep pace with energy consumption demands.

## **Gap Period**

Even if the US immediately implemented a bold and assertive effort to institute a broad energy policy, it would take decades before the US would be able to free itself from Middle Eastern oil dependency and provide environmentally safe energy sources. During this weaning period, the US would remain vulnerable to regional influences and longer term, adverse environmental consequences. An energy crisis could emerge from a myriad of probable scenarios that would not only affect the US but the International community as well. Examples include a collapse of the new Iraqi government, a fall of the Saudi monarchy, interruptions caused by al-Qaeda or other insurgency groups, or an oil embargo that could all lead a global economic meltdown.

Most analysts still paint an optimistic view that the Wahhabi religious establishment or even al-Qaeda would continue to sell oil to its enemies despite ideological differences because they need foreign money to sustain themselves. This is a credulous belief based on historical examples of Iran after the fall of the Shah and Iraq with the rise of Saddam Hussein [50].<sup>7</sup> In either case, the cost will be exponentially higher later than it is today as competition for supply increases and the response to counter a prolonged energy crisis becomes more limited. Tomorrow's cost will include the use of military and others responsible for restoring and protecting the flow of oil, potential loss of life and casualties, and a loss of good will for embroidering imperial tendencies if seizing control of selected oil fields is one of the selected responses.

The key point is to minimize the duration of this gap period by acting now to reverse significantly the share of energy provided by the Middle East and other foreign sources through

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<sup>7</sup> One of al-Qaeda's stated goals was to dislodge the Western countries out of the Middle East. In his article, "What Do We Do If the Saudi Monarchy Falls," Mark N. Katz contends a new regime needs oil revenue that would override its aversion of dealing with a hostile West.

assertive R&D, capital investments, and sound policy initiatives. Without viable, alternative energy sources capable of sustaining the US consumption demands as a substitute for Middle Eastern oil, the options available to the US and other oil starved countries are limited to a foreign policy that placates a new anti-American regime or the use of force requiring military assets.

## **Global Scenario/Response to a Major Energy Crisis**

A prolonged energy crisis or regime change in Saudi Arabia would dramatically escalate the price of oil per barrel in addition to depressing oil supply well below demand. Initially, this would lead countries dependent on foreign oil to tap oil reserves and increase energy conservation mandates while encouraging other exporting countries to increase production [51]. As the situation worsens under a severe energy crisis, the government would likely implement fuel rationing with remaining oil reserves protected for high priority requirements (e.g., military and emergency responders). The economy would start to suffer as consumer luxury consumption and travel dwindles while business costs skyrocket leading to recession and business failures as the duration of the energy continues. As the US economy spirals down, it would lead to global recession. Unimpeded, the worst-case scenario could cause global stock market crashes and depression.

Somewhere prior to global depression and market collapse, the international community will build new alliances previously thought unthinkable. National interests not normally in accord with the US would suddenly be in harmony. China and Germany's increasing dependency on foreign energy would likely cause them to join the US, England, and Japan in achieving political consensus on an appropriate response to the growing global energy dilemma.

"The logical defense strategy is to minimize the economic injury of supply disruptions by interrupting the chain of events that would lead to economic upheaval" [52]. Exporting countries such as Russia and highly self dependent countries such as France would likely oppose the use of military force to restore a regime that would open the flow of oil or protect selected oil fields and infrastructure (e.g., pipelines, port and shipping lanes) to enable the resumption of oil flow.

The hypothetical response scenario above to a prolonged deprivation of Middle Eastern oil demonstrates that events in the Middle East have significant bearing to the US, its economy, and national security. Due of long lead times required to reverse the dependency of foreign oil

dependency in the volatile Middle East; the US is already in the midst of an energy crisis. The energy crisis is real but because we are viewing it in slow motion from the relative calm of the storm's eye, it is not readily apparent that the most dangerous part has yet to come. The duration and seriousness of the energy crisis is dependent upon prompt and deliberate actions taken to alleviate dependency through alternative energy sources and effective policy implementations.

## **Recommendations**

The following recommendations are high-level measures necessary for immediate enactment to enable energy security and reduce harmful environmental emissions. A few of the recommendations such as incentives for solar energy use could see near-term benefit while other recommendations such as nuclear power RD&E will take one or two decades for the US to realize these long-term benefit. Each recommendation on its own is not sufficient to enable energy independence. Collectively, these recommendations form the foundation necessary to protect the environment while providing future generations with a reasonable degree of energy security.

- ? Continue efforts to diversify oil imports from nations other than those in the Middle East.
- ? Enact tougher fuel-efficiency targets for cars and trucks (commercial and residential). These higher levels are possible without bankrupting the automobile industry.
- ? Develop metrics focused on improving efficiency per barrel of oil.
- ? Reinvigorate government and commercial investment in nuclear power RD&E with focus on improving safety provisions that would eliminate the production of nuclear grade plutonium and significantly reduce waste issues.
- ? Develop programs to improve educational awareness regarding the use of nuclear energy.



- ? RD&E investments focused on recycle technology, passive safety assurance, and reducing capital costs [53].<sup>8</sup>
- ? Address safety and environmental concerns as the highest priority; maintain vigilant nuclear regulatory oversight, and determine appropriate actions to accelerating the licensing/re-licensing review processing.
- ? Lead the international community towards the development of closed cycle integrated fast breeder reactors in lieu of current breeder reactors that produce plutonium as a by-product.
- ? Implement tax incentives for use of solar energy on each house in America with the ability to “sell” unused energy back to the utility companies as an alternative energy source supplement to fossil fuel use.
- ? RD&E investment focused on the storing solar energy for later use.
- ? Expand potential of geothermal use and exploration for new source locations.
- ? Invest in the modernization of the electric power grid. This investment would include appropriate policies that ensure a coherent national electric grid strategy [54].<sup>9</sup>
- ? Expand RD&E funding for the short-term development of fuel cells and long-term development of a hydrogen economy.
- ? Mandate cleaner air requirements for coal and oil facilities.

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<sup>8</sup> Two fuel cycle technologies for an Advanced (Integrated) Fast Reactor available for a Generation IV by 2020 include an advanced aqueous process and the pyroprocess. These two processes achieve the benefits of breeder reactors while never separating plutonium at any stage making plutonium proliferation or theft impossible. By advancing this technology, the United States could continue to discourage worldwide any process that produces plutonium as a by-product.

<sup>9</sup> The United States does not have a national electric grid. Instead, there are four integrated regional transmissions grids with minimal interconnection between regions. Determination of new capability resides with the respective State that would host this capability even if the benefit of the increased capability expands outside the State. Although electricity crosses state boundaries (as well as international boundaries) much like Interstate Commerce, it is not subject to federal government oversight or adjudication.

- 2 Investigate the application of energy taxes/tariffs to products (both made in the US and imported) that are a by-product of cheaper but environmentally harmful energy sources.

The president must set the conditions, champion a national energy awareness agenda, and overcome partisan politics to pass through Congress a comprehensive energy policy that links foreign policy and energy security aims while simultaneously addressing environmental considerations. Partisan politics and interest groups must acquiesce to a nonpartisan, independent commission chartered to develop a rational, robust, environmentally friendly, and holistic energy policy that promotes realistic short-term sacrifices that will enable long-term energy security, sustainability and economic strength [55].<sup>10</sup>

## Conclusion

The imbalance between energy production of the US and demand that will continue to expand in future decades is alarming and threatens national security. “This imbalance, if allowed to continue, will inevitably undermine our economy, our standard of living, and our national security” [56].

Unfortunately, the likelihood of a non-partisan, holistic energy policy implementation that will wean the US from dependency on Middle Eastern oil within the next two to three decades is not promising. The political hurdles appear simply too high to declare war on energy dependence unless a new energy crisis changes the political landscape in much the same way as did 9/11. Without such a non-partisan declaration, each new administration will alter the predecessor’s energy agenda and the continuity of funding, policy and incentives required over a twenty-year span to achieve energy security. The cost of this failure to act now will be the required use of military force later to reopen the flow of oil and protect selected oil fields and infrastructure (e.g., pipelines, ports, and shipping lanes).

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<sup>10</sup> An approach similar to that employed by the bipartisan Defense Base Closure and Realignment Commissions (BRAC) maybe the only hope to avoid a watered down energy policy resulting from special interest group influence and the truism that politics is local. The President would submit to Congress an energy policy developed by the independent commission that must be accepted or rejected by lawmakers in its entirety.

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